

Sub H 27 28. (Twice Amended) An isolated gene encoding a protein, which gene encodes an amino acid sequence selected from the group consisting of the amino acid sequences as set forth in SEQ ID No. 1 to 6, or hybridizes with a nucleotide sequence selected from the group consisting of the nucleotide sequences as set forth in SEQ ID No. 1 to 6 under the condition of 5 x SSC and 50°C or the condition of 2 x SSC and 50°C, and which protein transfers an aromatic aryl group to flavonoid.

Please add the following new claim 53:

Sub H 47 53. An isolated acyltransferase gene which encodes a protein which transfers an aromatic acyl group to flavonoid.--

REMARKS

Entry of the foregoing, reexamination and further and favorable reconsideration of the above-identified application in light of the following remarks, pursuant to and consistent with 37 C.F.R. § 1.112, are respectfully requested.

By the present amendment, claims 1 and 28 have been amended to recite that the gene is an isolated gene. Support for this amendment to claims 1 and 28 may be found, at the very least, at page 5, line 31, to page 6, line 3. Claim 25 has been amended to make clear that what is being claimed is a plant, or a progeny thereof, which has had its color controlled. Support for this amendment to claim 25 may be found, at the very least, on page 10, lines 30-34, of the specification as filed. No new matter has been added by the present amendment.

Rejection of Claims 1-3, 5-12, 25-32, 36-38, and 42-52 Under 35 U.S.C. § 101

Claims 1-3, 5-12, 25-32, 36-38, and 42-52 have been rejected under 35 U.S.C. § 101, for purportedly claiming an invention directed to a non-statutory subject matter. The claims have been amended to recite that the gene is an isolated gene, thereby rendering moot this rejection.

In light of these remarks, applicants respectfully request withdrawal of this rejection under 35 U.S.C. § 101.

Rejection of Claims 1-3, 9-12, 20, 22, 23-27, and 46-47 Under 35 U.S.C. § 112, 1st

Claims 1-3, 9-12, 20, 22, 23-27 and 46-47 have been rejected under 35 U.S.C. § 112, first paragraph, because the specification purportedly does not contain a written description of the claimed invention. For at least all of the reasons set forth below, withdrawal of this rejection under 35 U.S.C. § 112, first paragraph, is respectfully requested.

The applicants have cloned many cDNA's which encode an enzyme having an aromatic acyl group transfer activity, and the specification describes the cDNA's which have been cloned. For example, in Example 6 the applicants describe cDNA of gentian origin; in Example 8, cDNA of petunia origin is disclosed; and in Example 20, cDNA of lavender origin is disclosed. The cDNA's disclosed in Examples 6, 8 and 20 were obtained using a hybridization method (described in the specification) to select desired cDNA. Example 11 describes a cDNA of perilla origin and Example 12 describes a cDNA

of cineraria origin. The cDNA's of both Examples 11 and 12 were obtained by using synthetic DNA primers.

One of skill in the art could obtain a protein having an aromatic acyl group transfer activity of any origin using the methods described in Examples 6, 8, 11, 12 and 20. Example 3(6) teaches the probe which is used in Examples 6 and 8 to obtain a protein with aromatic acyl group transfer activity. Example 20 uses the same hybridization method as that taught in Example 3, but with a different flower species (i.e., *lavandula angustifolia* as opposed to *petunia hygrida* or *gentian*).

In Example 11, the applicants compared amino acid sequences from the proteins obtained in Examples 3, 6 and 8, and determined that a amino acid sequence was conserved between these proteins. They used this sequence to produce a primer which will amplify aromatic acyl transfer genes. The applicants next used this primer to amplify DNA from a cDNA library developed from perillas, and obtained a protein with aromatic acyl group transfer activity. In Example 12, the primer was also used to screen for genes in *Senecio cruentus*. Thus, the applicants have shown that this protein has a conserved region which is found in all of the flower species discussed in the specification, and primers from this conserved region can be used to isolate proteins from other flower species. A specification may, within the meaning of 35 U.S.C. §112, first paragraph, contain a written description of a broadly claimed invention without describing all species.

Utter v. Hiraga, 6 USPQ2d 1709, 1714 (Fed. Cir. 1988). Applicants have adequately described how one of skilled in the art would obtain a protein having aromatic acyl transferase activity, and have even disclosed numerous proteins, from various species,

which they have isolated using their methods. Applicants do not need to provide sequence information for every protein which has aromatic acyl transferase activity in order to comply with the written description requirement of 35 U.S.C. § 112, first paragraph. Teaching how one of skilled in the art could obtain such proteins is enough to fulfill the written description requirement. Thus, the application provides written description support for the subject matter claimed.

It is believed at the very least that newly added claim 53 is allowable. Newly added claim 53 specifies that the gene is an isolated acyltransferase gene, thus defining the gene.

In light of these remarks, applicants respectfully request withdrawal of this rejection under 35 U.S.C. § 112, first paragraph.

Rejection of Claims 1-3, 5-12, 20 and 22-52 Under 35 U.S.C. § 112, 1st

Claims 1-3, 5-12, 20 and 22-52 under 35 U.S.C. § 112, first paragraph, because the specification purportedly only enables the isolation of the nucleotide sequences identified in SEQ ID Nos:1-6. For at least all of the reasons set forth below, withdrawal of this rejection is believed to be in order.

As discussed in more detail above, the applicants teach how one of skilled in the art could obtain proteins which have aromatic acyl group transfer activity. As discussed on pages 5 and 6 of the specification as filed, prior to the present invention all attempts to purify aromatic acyltransferases had failed. The inventors have developed a novel method for isolating aromatic acyltransferases. By using this method, one of skill in the art can isolate proteins which have aromatic acyl group transfer activity. The partial amino acid

sequence of the isolated protein is then elucidated using conventional methods. Using this sequence, one of skill in the art could isolate DNA's which encode the protein by any of a number of methods known to one of skill in the art. For example, using the amino acid sequence, one could develop a number of primers which could be used to amplify cDNA's from a cDNA library. Given that the genetic code is degenerative, one would have to develop a number of primers going in each direction (to cover all possible combinations of nucleic acids which would encode the amino acid segment). Using all possible combinations of the primers from each primer set (one set forward primer, one set reverse) one of skill in the art would then perform PCR on cDNAs from a cDNA library. Any cDNA determined to have been amplified would then be further analyzed by sequencing to determine if the cDNA encodes the isolated protein. Enablement is not precluded by the necessity for some experimentation. However, experimentation needed to practice the invention must not be undue experimentation. The "key" word is undue, not experimentation. Although this may require a good deal of experimentation, the experimentation would not be undue to one of skill in the art. In fact, this type of experimentation would be commonplace for one of skill in the art. Therefore, it is believed that the claims are enabled by the specification, given what is known to one of skill in the art.

In light of these remarks, applicants respectfully request withdrawal of this rejection under 35 U.S.C. § 112, first paragraph.

Rejection of Claim 25 Under 35 U.S.C. § 112, Second Paragraph

Claim 25 has been rejected under 35 U.S.C. § 112, second paragraph, for purportedly being indefinite. For at least all of the reasons set forth below, withdrawal of this rejection is believed to be in order.

Claim 25 has been amended to make clear that what is being claimed is a plant which has had its color controlled by introducing the gene of claim 1; or the progeny of said plant; or tissues from either the progeny of the plant or the plant itself. Applicants believe that one of skill in the art would not misunderstand this claim as meaning that the plant could have its color controlled by introducing thereinto its progeny.

In light of these remarks, applicants respectfully request withdrawal of this rejection under 35 U.S.C. § 112, second paragraph.

Rejection of Claims 5-6 and 42-45 Under 35 U.S.C. § 112, Second Paragraph

Claims 5-6 and 42-45 have been rejected under 35 U.S.C. § 112, second paragraph, for purportedly being vague and indefinite for the recitation of the term “consensus sequence.” For at least all of the reasons set forth below, withdrawal of this rejection is believed to be in order.

The terms “consensus” and “conserved” are interchangeable in the present specification. These terms mean a sequence common to different sequences. Attached as Exhibit A is a sequence alignment, in which the amino acid sequences of SEQ ID Nos:1-6 are aligned (GAT4=SEQ ID NO:1; LAT1-aa=SEQ ID NO:6; SAT208=SEQ ID NO:4; CAT8aa=SEQ ID NO5; GAT106=SEQ ID NO2; and PAT48=SEQ ID NO:3). In the

sequences, the amino acids marked with the asterisk are common between the sequences.

On the second page of this alignment, there is a sequence consisting of 6 continuous amino acids with asterisks, D-F-G-W-G-W (Asp-Phe-Gly-Trp-Gly-Lys). This is a consensus or conserved sequence or region. One of skill in the art would recognize this as a consensus region of SEQ ID Nos:1 to 6. Thus, it is believed that the claims are not vague and indefinite.

In light of these remarks, applicants respectfully request withdrawal of this rejection under 35 U.S.C. § 112, second paragraph.

CONCLUSION

From the foregoing, further and favorable action in the form of a Notice of Allowance is believed to be next in order, and such action is earnestly solicited.

In the event that there are any questions relating to this application, the Examiner is invited to telephone the undersigned so that prosecution of the subject application may be expedited.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

By:


Dawn M. Gardner
Registration No. 44,118

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620
Date: April 20, 2001



Application No. 08/894,356
Attorney's Docket No. 001560-308
Page 1

Attachment to Amendment and Reply dated April 20, 2001

Marked-up Claims 1, 25 and 28

1. (Three Times Amended) An isolated gene encoding a protein which transfers an aromatic acyl group to flavonoid.

25. (Three Times Amended) A plant whose color has been controlled by introducing thereinto a gene according to claim 1[,]; or the progeny of said plant wherein said [its] progeny [which] has its color controlled[,]; or tissues thereof.

28. (Twice Amended) An isolated gene encoding a protein, which gene encodes an amino acid sequence selected from the group consisting of the amino acid sequences as set forth in SEQ ID No. 1 to 6, or hybridizes with a nucleotide sequence selected from the group consisting of the nucleotide sequences as set forth in SEQ ID No. 1 to 6 under the condition of 5 x SSC and 50°C or the condition of 2 x SSC and 50°C, and which protein transfers an aromatic aryl group to flavonoid.

EXHIBIT A

USSN 08/894,356



SEQUENCE ALIGNMENT

GAT4:SEQ ID NO 1; LAT1-aa:SEQ ID NO6; SAT208:SEQ ID NO4;
CAT8aa:SEQ ID NO5; GAT106:SEQ ID NO2; PAT48:SEQ ID NO3

GAT4	1	MEQIQMVVKLEKQCQVTPPSDTIDVELSLPVTFPDIPWLHLNKMQSLLFYDFPYP	54
LAT1-aa	1	MTLLESSRVAPP-PGTVAEQSLPLTFFDMTWLHFHFMQLLFYELPCS	48
SAT208	1	VIETCRVAPP-PDSVAEQSVPLTPFDMDTWLHFHFMQLLFYEFPCS	45
CAT8aa	1	NILEHARISAP-SGTIGHSLSLTFFDITWLLFPPVHHLFFYDFPHS	51
GAT106	1	MAGNSEDIKYLEKCRVAPP-PDAVAEFTVPLSFPDMRWLISDAEHMLHFYRFRHP	54
PAT48	1	MAGEVAKQPVTKVKVLKKTNVP--HKPLGKKECQLVTIFDLPYLAFYYNQKFYIK--G	55

* * *

GAT4	55	RTHFLDTVIPNLKASISLTLKHYPVPLSGNLLMP	IIXSGEMPKFQYSRDEGDSIT	107
LAT1-aa	49	KPAFLETVVPKLKQSLSLTLKHFFPLSCNLIYP	LSPEKMPEFRYQ--NGDSVS	99
SAT208	46	KQHFSESVIPKLKQSLSKTLIHFPPPLSCNLIYP	SSPEKMPEFRYL--SGDSVS	96
CAT8aa	52	KSHFMDTIVPRLKQSLSVTLQHFFPPASNLIVFPNTD	GSGFNKKPEIRHVB--GDSVV	107
GAT106	55	CPNS-KFISSSIKSSLVSLKHPLPLAGNLIWP	VDSSDRMPELRYK--KGDSVS	105
PAT48	56	AENP-DETVEKIKDGLALVLVDPYQLAGKLKD	EEGVFRVEYDDD-MDGVEVT	106

* * *

GAT4	108	LIVAE	SDQDFDYLKCHQLVDSNDLHGLFYVMPrVIRTMQDYKVIPLVAVQ	157
LAT1-aa	100	FTIME	SSDDYEDLVGDHPHSAHKYCCAPQLPPIV-EESDRKLQVLAQ	148
SAT208	97	FTIAE	SSDDFDDLVGNRPESPVRLYNFVPLKPPIV-EESDRKLQVFVQ	145
CAT8aa	108	VTFAE	CCLDFNNLNTGNHPRKCENFYPLVPSLGNAI-KLCDCVTVPLFSLQ	156
GAT106	108	LTIAE	SSMDPDYLAGDHQKDSYKFNDLIPQLPEPIVTSQD-EVLPFLAQ	154
PAT48	107	VAVA2	EIEVADLTD--EEGTTKFQDLIPCNKILN--LEGLHRPLLAVQ	150

* * *

GAT4	158	VTVPNRGIAVALTAMHSIADAKSPVMFINAWAYINKFGKDADLLSAN	--LLPSFDRSII	215
LAT1-aa	149	VTLPGRGVICIGITTHHTVSDAPSFGFMKSWSAITKFGGDEF	LDGKGECLPVFDRSLV	208
SAT208	146	VTLPGRGVGIGIATHHTVSDAPSFLAFITA	WSSMSKHIEN-EDEDEEFKSLPVFDRSVI	204
CAT8aa	157	YTFPPGSGISLGMTNHSLGDASTRFNFLKGWTSIIQSGVDRSFLTKG	-SPPVFDRLIN	214
GAT106	155	VTVPNTGICIGRNLHQVLDASSPLHFNLWVLVDKSNGD-SLKFLPLSSLPMYDRSVV	213	
PAT48	151	LTKLKD-GLTMGLAFNHAVIDGSTWHPMTSWSELCCGTSISVPPFLERTKARNTRV	KLN 209	

* * *

GAT4	216	KDLYGLEETFWNEQMVDVLEMFSRP	-GSKPPRFNKVRATYVLSLAEIQKLENKVLNLRGS	273
LAT1-aa	209	NYPPKLDTYLWNNAQ-KRPLESQ	--HPSLPTDRIRATYLFTQSEIKKLKGLIQRKAPN	263
SAT208	205	KYPTKFDSIYWRNAL-KFPLQSR	-HPSLPTDRIRATYLFTQSEIKKLKGLIQRKAPN	259
CAT8aa	215	-IPHLDENKLRRHTRLESFYKPS	-SLVGPTDKVRSTFVLTTRTNINLLKKKVLTQVPN	268
GAT106	214	QDPFHIRRKIYNERK-LLKSQCTPTVLNPASI	KDEVRAFILEHPIDIMLKKPYISSKRN	272
PAT48	210	NLSQPSDAPEHAKSATNGDVPA	--VDPPLRER-VFKFSELAIIDKIKSTVNANSGB	262

* * *

GAT4 274 EP—TIRVITFTMTCGYWTCMVSKDDVVSEESSNDENELEYFSFTADCRGLLTPPCP 330
 LAT1-aa 264 ——VNLSSFVAIAAYIWTGIAKS—VGDYKDVIDDKR—AFFLIPIDLRPRLDPPAP 314
 SAT208 260 ——LVHLSSFVAIAAYMWAGITKS—FTADEDQDNED—AFFLIPVDLRPRLDPPVP 309
 CAT8aa 269 ——LEYMSSFTVTCGYIWSCIASKS—LVKIGERKGDE—LEQFIITIDCRSRLDPPIP 320
 GAT106 273 LTCGSSNTNLSTFTVTSALIWTCLSks—LDTVVVRBKVEEDKHAANLCFINCRQRFAPPiP 331
 PAT48 263 ——TPFPSTPQSLSAHVWLAVTRA—R—QLKPED—YTIVYTFADCRKRVDPPMP 308

* *** *

GAT4 331 PNYFGNCLASCVAKATHKELVGDKGLLVAVAALGEAIEKRLHNEKGVLADAKTWLS—ESN 389
 LAT1-aa 315 GNYFGNCLSPAMAKILRRDLVGDEGVFRRAEALAAEIEKRTSDK—KILETVENWPS—EIR 372
 SAT208 310 ENYFGNCLSYALPRMRRRELVGEGKVFLAAEVIAAEIKRINDK—RILETVEKWSP—EIR 367
 CAT8aa 321 TAYFGNCAPCVP TLKVNVLTSENGYALGAKVIGESICKMIYNKDGILKDAARWHE—P 377
 GAT106 332 QNYFGNCIVPCMVGSTHEQLVGNEGLSVATAIGDAIHKLHDYEGILRGDWISPPRSTS 391
 PAT48 309 ESYFGNLIQAIFTVTAAGLLASPIEFGGMICQQAIYKHDAKAIDERNKEWESENPKIFQY 368

* *** *

GAT4 390 GIPSKRFLGITGSPK—FD SYGVDFGWGKPAKFDTSVDYAELIYVIQ—SRDFEKGVIEIG 446
 LAT1-aa 373 EALQNCYFVSAGSSR—LDLYGADFGWGKAVKQEILSIDGEKPTMSLCKPRDAAGGLEVG 430
 SAT208 368 KALQKSYPVSAGSSK—LDLYGADFGWGKARKQEILSIDGEKYAMTLCKARDFEGGLEVC 425
 CAT8aa 378 FMIPARKIGVAGTPK—LNLYDFDFGWGKPIKYETVSDYN—TSISINASKTSAQDLBIG 434
 GAT106 392 AAPRSTLIYVVGSAQRNVHDFDADFGWGKLEKHESVSTNPSATLILISRSRRFKGALEG 451
 PAT48 369 KDAGVNCVAVGSSPR—FKVYDVDFGWGKPESVRSGSNRFDGMVYLYQGKNGGRSIDVE 426

* ***** *

GAT4 447 VSLPKIHMDAFAKIPEEGPCSL 469
 LAT1-aa 431 LSLPKEELQAFDDYFAEGIKG 451
 SAT208 426 LSLPKDRMDAFAAAYPSLGING 446
 CAT8aa 435 LSLPSMQMEAFSSIFDEGLESQVSL 460
 GAT106 452 ISLPKNRMDAFATIFTNPINSLHVRSP 479
 PAT48 427 ISLEANAMERLEKDKEFLMETA 448

*